Apprenticeship and Industry Training

Outdoor Power Equipment Technician

Apprenticeship Course Outline

5106 (2006)

Alberta
Advanced Education
Apprenticeship and Industry Training

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Outdoor Power Equipment Technician

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Apprenticeship and Industry Training System

Apprenticeship is post-secondary education with a difference. It helps ensure Alberta has a steady supply of highly skilled employees, the foundation of our economy's future health and competitiveness.
Apprentices in more than 50 trades and crafts spend between one and four years learning their trade - 80% of the time on the job under the supervision of a certified journeyman or qualified tradesperson. The balance of the program is technical training in the theory, skills and technologies of their trade.
To become certified journeymen apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board (the Board) and a network of local and provincial industry committees.
The graduate of the Trade Name apprenticeship training is a journeyman who will be able to:

- Perform all tasks expected of a journeyman efficiently in accordance with industry standards.
- Supervise, train and coach apprentices.
- Service, maintain, repair and rebuild outdoor power equipment and outdoor power equipment accessories
- Communicate clearly with customers, staff, suppliers, as required.
- Work in accordance with the laws and regulations governing the industry
- Work safely, and ensuring the safety of other workers and the general public.

Apprenticeship and Industry Training Committee Structure

While government supports Alberta's apprenticeship and industry training system, it is driven by industry, a term which includes both employers and employees. The Alberta Apprenticeship and Industry Training Board, with the support of Alberta Advanced Education, oversees the system. But the system relies on a network of industry committees. These committees include local and provincial apprenticeship committees (LACs and PACs) in the designated trades and occupational committees (OCs) in the designated occupations, as well as other committees such as provisional committees established before the designation of a new trade or occupation comes into effect. All these committees are composed of equal numbers of employers and employees. The network of industry committees is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a LAC. The Board appoints equal numbers of employees and employers for terms of up to three years. The committee appoints a member as presiding officer. Local Apprenticeship Committees:

- monitor the apprenticeship system, and the progress of apprentices in their trade, at the local level.
- help settle certain kinds of issues between apprentices and their employers.
- recommend improvements in apprenticeship training and certification to their trade's provincial apprenticeship committee.
- make recommendations to the Board regarding the appointment of members to their trade's PAC.

Provincial Apprenticeship Committees (PAC)

The Board establishes a PAC for each trade and, based on PAC recommendations, appoints a presiding officer and equal numbers of employees and employers for terms of up to three years. Most PACs have nine members. Provincial Apprenticeship Committees:

- identify the training needs and content for their trade.
- recommend to the Board the standards for training and certification for their trade.
- monitor the activities of local apprenticeship committees in their trade.
- make recommendations to the Board about the designation of trades and occupations.
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in the trade.
- may participate in resolving any apprenticeship-related disputes between employers and employees.

Outdoor Power Equipment Technician PAC Members

Mr. C. Flathers	Calgary	Presiding Officer
Mr. C. Cloutier	Calgary	Employer
Mr. R. Macmillian	Calgary	Employer
Mr. T. Sedgwick	Calgary	Employer
Mr. T. Tupper	Edmonton	Employer
Mr. E. Williamson	Fort Macleod	Employer
Mr. S. Yee	Edmonton	Employer
Mr. A. Fluet	Onoway	Employee
Mr. D. Swainson	Calgary	Employee
Mr. W. Weiss	Edmonton	Employee

The Alberta Apprenticeship and Industry Training Board (Board)

The mandate of the Alberta Apprenticeship and Industry Training Board relates to the standards and requirements for training and certification in programs under the *Apprenticeship and Industry Training Act*. The Board provides advice to the Minister of Advanced Education on the training and certification of people in designated trades and occupations and on the needs of the Alberta labour market for skilled and trained persons. The Board also makes orders and regulations respecting standards and requirements for apprenticeship programs and the training of apprentices and for training and certification in designated trades and occupations, and the criteria or requirements for granting and recognizing trade and other certificates.
The 13-member Board consists of a chair, eight members representing trades and four members representing other industries. Employer and employee representatives equally represent the trades and other industry members.

Safety Education

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees and the public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to or cause an accident or injury.
It is generally recognized that a safe attitude contributes to an accident free environment. Everyone will benefit as a result of a healthy, safe attitude towards prevention of accidents.
A tradesperson is possibly exposed to more hazards than any other person in the work force and, therefore, should be familiar with and apply the Occupational Health and Safety Act and Regulations dealing with personal safety and the special safety rules applying to each task.

Legal and Administrative Aspects of Safety

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer and employee.

Employer's Responsibilities

The employer is responsible for:

- providing and maintaining safety equipment and protective devices.
- ensuring proper safe work clothing is worn.
- enforcing safe working procedures.
- providing safeguards for machinery, equipment and tools.
- observing all accident prevention regulations.
- training employees in the safe use and operation of equipment.

Employee's Responsibilities

The employee is responsible for:

- working in accordance with the safety regulations pertaining to the job environment.
- working in such a way as not to endanger themselves or fellow employees.

Occupational Health and Safety's Responsibilities:

Occupational Health and Safety (Alberta Human Resources and Employment) will conduct periodic inspections of the workplace to ensure that safety regulations for industry are being observed.

Technical Training Establishment

Alberta Advanced Education, Apprenticeship and Industry Training offer your apprenticeship training program. Staff and facilities for delivering the program are supplied by:

- Northern Alberta Institute of Technology (Patricia campus)

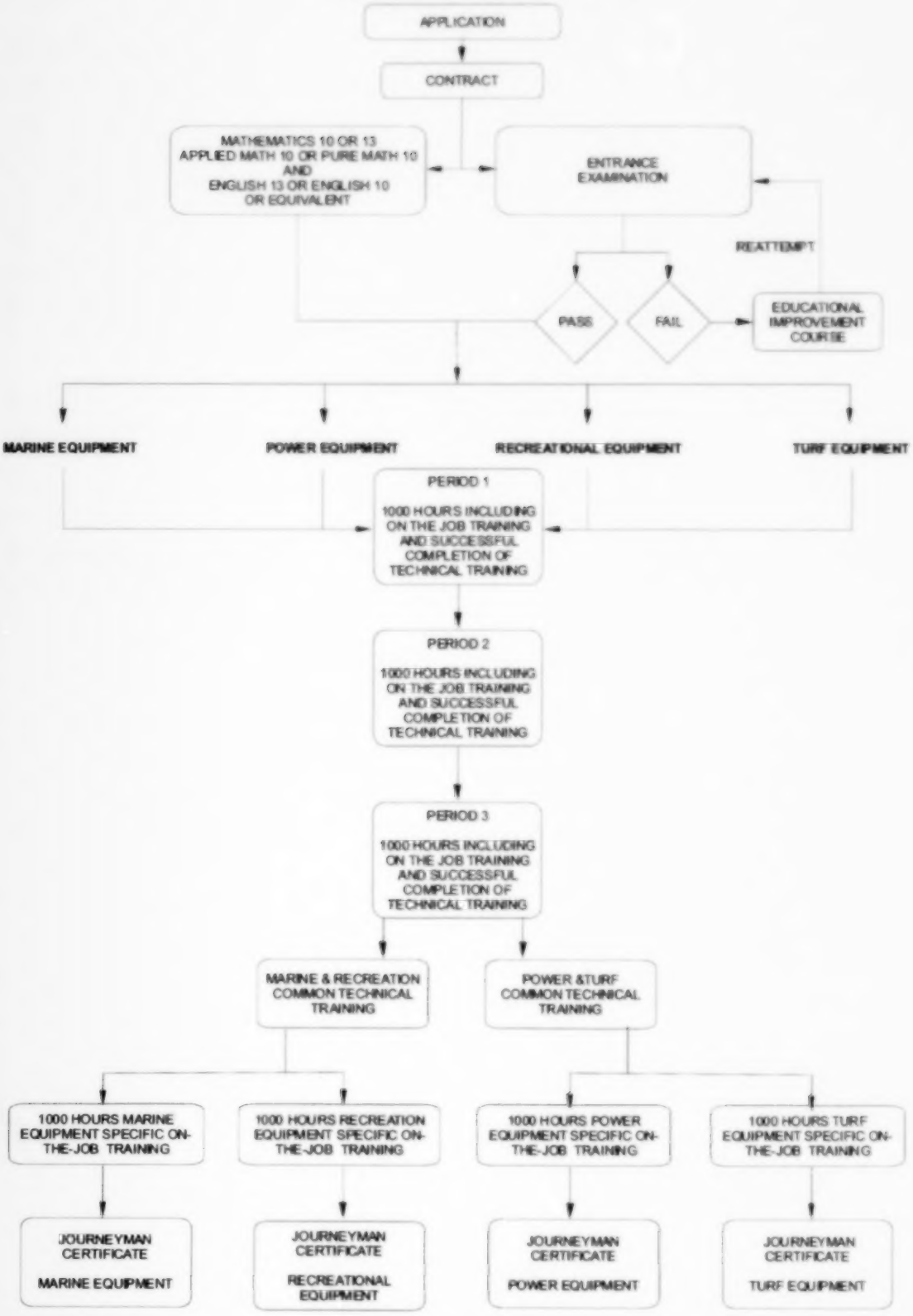
Procedures For Recommending
Revisions To The Course Outline

Apprenticeship and Industry Training, Industry Programs and Standards has prepared this course outline in partnership with the Outdoor Power Equipment Technician Provincial Apprenticeship Committee.
This course outline was approved on June12, 2006 under the authority of the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. Valuable input is acknowledged from industry and the institutions.
Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to:

Outdoor Power Equipment Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
10th floor, Commerce Place
10155 - 102 Street
Edmonton, AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Outdoor Power Equipment Technician Training Profile

FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE	A	B	C
OUTDOOR POWER EQUIPMENT LAWS AND REGULATIONS 15 HOURS	Equipment and Shop Safety 5 Hours	Laws and Liabilities 5 Hours	Fire Prevention and Control 5 Hours
SECTION TWO	A	B	C
MACINE SHOP PRACTICES AND WELDING 45 HOURS	Tools 2 Hours	Electrical Test Equipment 4 Hours	Measuring Tools 6 Hours
	D	E	F
	Bench and Power Tools 6 Hours	Welding 24 Hours	Fasteners 3 Hours
SECTION THREE	A	B	C
BASIC ELECTRICAL 32 HOURS	Electical Safety 1 Hour	Electrical Principles 12 Hours	Batteries 3 Hours
	D	E	
	Circuits 10 Hours	Wiring and Connections 6 Hours	
SECTION FOUR	A	B	
BEARINGS AND SEALS 12 HOURS	Bearings 9 Hours	Seals 3 Hours	
SECTION FIVE	A	B	C
COMMUNICATION AND MANUALS 20 HOURS	Service and Parts Manuals 6 Hours	Customer Service 8 Hours	Work Orders 6 Hours
SECTION SIX	A	B	
ASSEMBLY AND PRE DILIVERY 18 HOURS	Unloading - Uncrating 9 Hours	Assembly PDI and storage 9 Hours	
SECTION SEVEN	A	B	
WHEELS BRAKES AND TIRES 36 HOURS	Wheels and Tires 12 Hours	Brakes 24 Hours	
SECTION EIGHT	A	B	C
CARBURETTORS, FUEL, PUMPS AND TANKS 24 HOURS	Fuels 2 Hours	Fuel Pumps Tanks and Lines 6 Hours	Carburettors 16 Hours
SECTION NINE	A	B	C
ENGINES 38 HOURS	Four Stroke Engines 16 Hours	Two Stroke Engines 16 Hours	Governors 6 Hours

SECOND PERIOD

(8 Weeks 30 Hours per Week – Total of 240 Hours)

	A	B	C
SECTION ONE **FRAMES AND SUSPENSIONS** 14 HOURS	Frames 2 Hours	Suspension 6 Hours	Steering Systems 6 Hours
SECTION TWO **INTAKE AND FUEL INJECTION** 36 HOURS	Induction 6 Hours	EFI 18 Hours	Diesel 12 Hours
SECTION THREE **SPARK IGNITION SYSTEMS** 28 HOURS	Magneto 10 Hours	Low and High Tension Circuits And Components 12 Hours	Ignition Start and Interlock Circuits and Components 6 Hours
SECTION FOUR **CHARGING SYSTEMS** 20 HOURS	Alternators 20 Hours		
SECTION FIVE **STARTING SYSTEMS** 30 HOURS	Starters 30 Hours		
SECTION SIX **EXHAUST SYSTEMS** 12 HOURS	Exhausts and Mufflers 6 Hours	Emission Control 6 Hours	
SECTION SEVEN **COOLING SYSTEMS** 18 HOURS	Air Cooling 2 Hours	Liquid Cooling 10 Hours	Oil Cooling 6 Hours
SECTION EIGHT **LUBRICATION SYSTEMS** 12 HOURS	Oil 1 Hour	Oil Pumps 6 Hours	Oil Filtration 1 Hour
	D Lubrication Circuits 1 Hour	**E** Two Stroke Lubrication 3 Hours	
SECTION NINE **TUNE UP AND TROUBLESHOOTING** 70 HOURS	**A** Air Filters 55 Hours	**B** Engine Management Systems 15 Hours	

THIRD PERIOD

(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

HYDRAULICS — 80 HOURS

A	B	C
Hydraulic Basics — 6 Hours	Pumps and Motors — 12 Hours	Cylinders — 12 Hours
D	**E**	**F**
Lines — 1 Hour	Hydraulic Fluids — 1 Hour	Control Valves — 2 Hours
G	**H**	**I**
Pressure Valves — 2 Hours	Fluid Drives — 3 Hours	Testing — 41 Hours

SECTION TWO

BASIC DRIVES — 60 HOURS

A	B	C
Gear and Drive Ratios — 3 Hours	Belt Drives — 3 Hours	Chain Drives — 3 Hours
D	**E**	
Clutches — 20 Hours	Transmission — 20 Hours	
G	**H**	
Differentials — 6 Hours	Drive Shafts and Universal Joints — 2 Hours	

SECTION THREE

ENGINE OVERHAULS — 90 HOURS

A	B	C
Engine Failures — 2 Hours	Measurement and Inspection — 30 Hours	Recondition Parts — 20 Hours
D	**E**	
Reassembly of Engines — 35 Hours	Testing of Rebuilt engine and Final Adjustments — 3 Hours	

SECTION FOUR

ADVISORY NETWORK AND COACHING SKILLS — 10 HOURS

A
Advisory Network and Coaching Skills — 10 Hours

FOURTH PERIOD MARINE AND RECREATION

(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

FUEL SYSTEMS — 30 HOURS

A	B	C
Marine Fuel Systems — 1 Hour	Advanced Carburetion — 2 Hours	Carburetor Troubleshooting — 10 Hours

D	E	F
Jetting Principles — 2 Hours	Oil Injection — 3 Hours	Advanced Fuel Injection — 12 Hours

SECTION TWO

IGNITION SYSTEMS — 25 HOURS

A
Marine and Recreation Ignition Systems — 25 Hours

SECTION THREE

MARINE GEAR HOUSINGS — 25 HOURS

A	B	C
Shifting — 2 Hours	Shimming — 20 Hours	Transom Plates — 3 Hours

SECTION FOUR

JET DRIVES — 10 HOURS

A	B
Pumps — 2 Hours	Jet Drive Maintenance — 8 Hours

SECTION FIVE

POWER TRIM — 20 HOURS

A
Power Trim — 20 Hours

SECTION SIX

PROPS AND HULLS — 10 HOURS

A	B
Props — 6 Hour	Hulls — 4 Hours

SECTION SEVEN

RECREATION DRIVE TRAINS — 30 HOURS

A	B	C
Recreational Vehicle Clutches — 20 Hours	Tracks — 2 Hours	Driveline — 8 Hours

SECTION EIGHT

STEERING AND SUSPENSION — 20 HOURS

A	B	C
Steering — 5 Hours	Shocks — 5 Hours	Front Suspension — 5 Hours

D
Rear Suspension — 1 Hour

SECTION NINE

ACCESSORIES AND PERFORMANCE MODIFICATION — 10 HOURS

A	B	C
Electrical Accessories — 1 Hour	Engine Accessories — 5 Hours	Hull Accessories — 3 Hours

D
Trailer Accessories — 1 Hour

FOURTH PERIOD TURF AND POWER
(6 Weeks 30 Hours per Week – Total of 180 Hours)

SECTION ONE

ADVANCED FUEL SYSTEMS — 25 HOURS

- A: Power and Turf Equipment EFI and Sensor Servicing — 10 Hours
- B: Liquid Petroleum Gas — 3 Hours
- C: Kerosene — 1 Hour
- D: Diesel — 11 Hours

SECTION TWO

ADVANCED TRANSMISSIONS — 25 Hours

- A: Transaxles — 6 Hours
- B: Shift Mechanisms — 1 Hour
- C: PTO Drives — 2 Hours
- D: Final Drives — 6 Hours
- E: Hydrostatic Drives — 10 Hours

SECTION THREE

ELECTRICAL/ELECTRONIC CONTROL SYSTEMS — 25 Hours

- A: Safety Interlocks and Relays — 15 Hours
- B: Computer and Automated Control Systems — 10 Hours

SECTION FOUR

CUTTING UNITS — 30 Hours

- A: Mowing Equipment — 1 Hour
- B: Mower Set-up — 4 Hours
- C: Blade Sharpening — 20 Hours
- D: Chainsaw Chain and Cutting Bar — 5 Hours

SECTION FIVE

POWER EQUIPMENT — 30 HOURS

- A: Hand Held Power Equipment — 10 Hours
- B: Portable Water Pumps — 4 Hours
- C: High Pressure Washers — 6 Hours
- D: Portable Generators — 10 Hours

SECTION SIX

SPRAYERS — 10 HOURS

- A: Sprayer Equipment Chemicals and Handling — 4 Hours
- B: Sprayer Maintenance — 6 Hours

SECTION SEVEN

IRRIGATION — 20 HOURS

- A: Irrigation Hydraulics — 1 Hour
- B: Irrigation Equipment — 9 Hours
- C: Irrigation System Service — 10 Hours

SECTION EIGHT

GOLF CARTS — 15 HOURS

- A: Electric Carts And Chargers — 10 Hours
- B: Golf Cart Mechanicals — 5 Hours

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training

FIRST PERIOD TECHNICAL TRAINING
OUTDOOR POWER EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:.....OUTDOOR POWER EQUIPMENT LAWS AND REGULATIONS.....15 HOURS

A. Equipment and Shop Safety..... 5 Hours

Outcome: Describe personal and equipment safety in the Outdoor Power Equipment trade

1. Describe what is meant by safe work habits
2. Describe the use of personal protective equipment, identifying where and when equipment is required, including
   a) Suitable clothing, gloves, securing loose clothing, hair etc.
   b) footwear
   c) eye protection
   d) hearing protection
   e) bump hats, hard hats
   f) Personal protection for welding and cutting with oxyacetylene equipment.
   g) Personal protection for welding and cutting with electric welding equipment.
3. Identify the hazards associated with jewellery, such as watches, rings, bracelets, etc.
4. Describe required actions following an accident in the workplace.
5. Describe occupation health and safety regulations applicable to outdoor equipment repair.
6. Describe how the workplace hazardous materials information's system works:
   a) labels
   b) msds sheet
   c) prohibited products
   d) restricted products
   e) controlled products
7. Describe Transportation of dangerous goods legislation.
8. Describe procedures for shipping and receiving hazardous materials/dangerous goods.
9. Describe actions required in the event of a spill of hazardous materials.

B. Laws and liabilities ..... 5 Hours

Outcome: Briefly describe the legal obligations of the outdoor power equipment repair shops and technicians for warranties, servicing equipment, or evaluating equipment for safe operation.

1. Describe warranties, including the responsibilities and obligations of the:
   a) dealer
   b) customer
   c) technician
   d) factory or distributor
   e) third party warrantor
2. Explain the technician's legal responsibilities for servicing and releasing unsafe equipment including where equipment safety devices have been removed or altered.
3. Describe the equipment shop's responsibilities and liabilities for customer's equipment in their care.

C. Fire prevention and control ..... 5 Hours

Outcome: Describe fire prevention and fire extinguishing for the outdoor power equipment repair shop.

1. Identify and describe classes of fires.
2. Be able to select the appropriate fire extinguisher, fire control method for each class of fire.
3. Describe fire extinguishers and sprinkler systems common to equipment repair shops, including:
   a) hand operated fire extinguishers
   b) automated sprinkler systems
   c) fire retardants (eg, water, co2, halon, foam, dry chemical etc.)
   d) inspection and maintenance requirements
4. Describe methods of prevention potential fire hazards in the outdoor equipment shop:
   a) storage and disposal of flammable materials
   b) housekeeping
   c) dealing with leaks, spills of flammables
5. Describe fire emergency procedures.
6. Describe how to deal with the hazards of fire outbreaks, including:
   a) smoke and or toxic gases
   b) entrapment
   c) electrical panels, wiring etc.

SECTION TWO ..... MACHINE SHOP PRACTICES AND WELDING ..... 45 HOURS

A. Tools ..... 2 Hours

Outcome: Identify, select and use hand tools.

1. Identify and describe the use of the hand tools, including:
   a) wrenches
   b) sockets
   c) hammers
   d) pliers, snap ring pliers, circlip pliers
   e) screwdrivers – allen wrenches
   f) hacksaw
   g) snips, shears, side cutters, bolt cutters
   h) chisels, punches, pry bars, alignment (taper) punch
   i) files
   j) impact drivers
   k) pullers
   l) specialty shop / factory tools
   m) scrapers
   n) tire and wheel servicing hand tools
   o) chain breakers
   p) valve spring compressors, piston ring compressors and expanders
   q) bearing, bushing and seal drivers and extractors
   r) drill bit sharpening
   s) taps, dies, thread chasers, thread files
   t) stud removers - extractors

B. Electrical testing tools 4Hours

Outcome: Identify and describe the use of electrical tools, including:

1. multi meters (digital and analog) volt meters, ohm meters, ammeters
2. continuity testers
3. battery chargers
4. ignition (spark) testers
5. timing lights
6. tachometers
7. Engine and system diagnostic tools, scopes, scanners, code readers etc.
8. Use PC or laptop computers with diagnostic interfaces and software

C. Measuring Tools ..... 6 Hours

Outcome: Make accurate measurements using measuring tools.

1. machinists rules, straight edge
2. tape measure.
3. micrometers (inside, outside, depth) digital and conventional.
4. telescoping gage.
5. callipers (vernier dial and digital).
6. dial indicators.
7. surface plates, levelling plates, machinist's squares etc.
8. feeler gage hole gage thread gage.
9. compression gage, vacuum gage, pressure gages.
10. crankcase and cylinder head leak or leakdown testers.
11. torque wrenches.
12. plastic gage, mechanics dye etc.

D. Bench and Power tools ..... 6 Hours

Outcome: Identify and describe the use of bench tools and power tools, including:

1. bench vice.
2. impact wrenches
3. rotary and angle grinders
4. portable drills.
5. drill press.
6. presses
7. engine stands
8. using ovens, heat guns, etc. to heat parts
9. jacks and hoisting equipment
10. bench grinders, select and mount grinding wheels, wire wheels and polishing wheels, use wheel dressers
11. tire mount demount machine, tire bead breakers, wheel balancing equipment
12. describe air compressor adjustment and routine maintenance procedures for compressors and lines.
13. pressure washers

14. parts cleaners, degreasers, cleaning tanks
15. boring bars and honing machines
16. valve grinding and valve seat reconditioning tools
17. other tools, (benders, clamps, jigs, anvils etc.)
18. making special purpose tools

E. Welding ..... 24 Hours

Outcome: Set up and operate welding equipment.

1. Describe the hazards associated with welding equipment and operating welding equipment.
2. Describe the hazards associated with welding fumes, vapours, UV rays, etc.
3. Describe the oxyacetylene welding and cutting fittings and component assembly and disassembly.
4. Describe backfires, flashbacks etc. and how they are prevented.
5. Describe regulator and flame adjustments; identify neutral, oxidizing and carburizing flames.
6. Cut mild steel using oxyacetylene equipment.
7. Make a brazed lap joint using oxyacetylene equipment.
8. Assemble and set up portable MIG welders.
9. Inspect MIG welder component condition and correct if required.
10. Describe MIG welder adjustment.
11. Make the following welds using a MIG welder on mild steel, 6 mm to 1.2 mm:
    a) stringer beads
    b) butt weld
    c) lap weld
    d) corner and fillet
    e) spot welds

F. Fasteners ..... 3 Hours

Outcome: Identify, remove, and replace fasteners according to manufacturer or industry specifications.

1. Identify metric and US standard threaded fasteners by:
    a) thread type and class
    b) thread pitch
    c) length and diameter
    d) head type
2. Install threaded fasteners using manufacturer or industry torque tables and tightening patterns.
3. Describe the use of thread locking methods, including:
    a) lock nuts
    b) lock washers
    c) anaerobic thread lockers
    d) cotter pins etc.
4. Remove and replace non threaded fasteners (snap rings etc.)
5. Install pop rivets etc.
6. Remove rivets.

SECTION THREE .....BASIC ELECTRICAL.....30 HOURS

A. Electrical Safety for outdoor power equipment ..... 1 Hour

Outcome: Describe the safe work practices for electrical power tools, outdoor power system electrical systems, and portable generators.

1. Describe what is meant by a CSA/UL labeli r electric tools, appliances, cords etc.
2. Describe the dangers of working with domestic current produced by portable generators (110-240 V).
3. Describe the dangers of DC current.
4. Describe the hazards associated with overloaded or shorted wires.

B. Electrical principles ..... 10 Hours

Outcome: Describe the basic electrical circuit, define resistance voltage and amperage, calculate power calculate voltage resistance or amperage.

1. Describe the following:
   a) electrical safety
   b) voltage
   c) amperage
   d) resistance
   e) conductors and insulators
   f) dc and ac
2. Calculate power (watts) given voltage and amperage.
3. Calculate voltage, amperage and resistance in a circuit using the formula V=IR.
4. Measure voltage, amperage and resistance using meters.

C. Batteries ..... 3 Hours

Outcome: Perform battery construction, maintenance, storage removal and installation.

1. Describe battery types and construction used in outdoor power equipment.
2. Prepare batteries for service, fill with electrolyte and charge where applicable.
3. Describe battery disposal.
4. Test and Diagnose battery condition, charge and specific gravity (if applicable).
5. Describe battery chargers and how to operate them.
6. Describe battery short and long term storage.
7. Describe battery installation.
8. Describe battery maintenance, maintain electrolyte levels, checking for corrosion, sulphation etc.

D. Electrical Circuits for power equipment ..... 10 Hours

Outcome: Describe the basic electrical circuit types and circuit faults typical for outdoor power equipment.

1. Define the basic electrical circuit types and their faults, including:
   a) series circuit
   b) parallel circuit
   c) ground (dc)
   d) short
   e) open
   f) loads
   g) Switches
   h) Fuses and circuit breakers
2. Describe outdoor power equipment circuits including:
   a) ignition circuit with interlocks
   b) charging circuit
   c) aftermarket accessory circuits (eg radio, grip or seat heaters)
   d) electric trailer brake circuit
   e) winch circuit using relays
   f) battery operated starting motor
   g) Line voltage starting motor
   h) Lighting circuits
   i) Warning light and instrumentation circuits
   j) Fuse and or circuit breaker circuit

E. Electrical wiring ..... 6 Hours

Outcome: Install or repair electrical circuit components on outdoor power equipment.

1. Describe electrical wire and insulation types and sizes and how to select the correct wire for a circuit and application.
2. Disassemble and reassemble electrical components and wiring harnesses.
3. Inspect wires, insulation, connectors, harnesses, ties, grommets, heat shields etc. for faults and or damage.
4. Describe soldering of electrical components including:
   a) Solder type
   b) Flux type and purpose of flux
   c) Heat sources, heat requirements for soldering
   d) Preparation of solder joint, components to be joined
5. Prepare wire for connections (strip insulation, clean as applicable).
6. Make a soldered electrical joint.
7. Replace or install solderless wire connections common to outdoor power equipment.
8. Construct a 12 volt circuit featuring loads in parallel, a relay, a fuse and an indicator (power) light, and a switch.
9. Using test equipment, troubleshoot a circuits for faults such as:
   a) short
   b) open
   c) ground fault
   d) faulty switches
   e) faulty components
   f) faulty connections, plugs

SECTION FOUR .....BEARINGS AND SEALS.....12 HOURS

A. Bearings 9..... 9 Hours

Outcome: Remove, service and replace bearings on outdoor power equipment

1. Describe the characteristics of plain bearings
   a) Bushings
   b) Insert / shell
   c) Thrust washers
   d) Plain bearing materials /brass bronze white metal
2. Describe the characteristics and types of roller or antifriction bearings:
   a) ball
   b) roller
   c) needle
   d) tapered roller
   e) thrust bearings
   f) bearing identification and ordering
3. Describe other bearing types, such as sprag clutches, CVT components.
4. Describe what is meant by radial and axial loads and compare the characteristics of bearing types for radial and axial loads.
5. Describe bearing lubrication requirements for the various classes of bearings.
6. Remove anti friction bearings, clean, inspect pack, install.
7. Adjust tapered roller bearings (eg wheel bearings).
8. Remove, replace and when applicable, finish size plain bearings.
9. Diagnose common bearing faults.

B. Seals ..... 3 Hours

Outcome: Remove and replace seals on outdoor power equipment.

1. Describe the operating characteristics of the following types and classes of seals:
   a) gaskets – paper- neoprene – composite - metal
   b) o rings, quad rings, x rings
   c) sealants – gasket compounds
   d) lipped seals
   e) labyrinth seals
   f) piston rings
   g) ceramic seals
   h) other seal types
2. Remove, and replace gaskets and seals in outdoor power equipment.
3. Describe generic seal and sealant identification and ordering.

SECTION FIVE .....COMMUNICATION AND MANUALS.....20 HOURS

A. Service and Parts Manuals ..... 6 Hours

Outcome: Use service manuals and parts manuals to find service procedures and parts numbers

1. Using model identification, serial number etc., locate and access the correct service manual and parts manual for outdoor power equipment:

a) Access manuals using the following methods
b) print
c) digital media
d) Computer terminal, internet, or other on line systems
e) Microfiche

2. Use service manuals to find:

a) maintenance intervals and procedures
b) capacities
c) service and repair procedure
d) Specifications etc.

3. Use parts manuals to identify parts part numbers and components.

4. Describe typical parts ordering procedures. for outdoor power equipment.

B. Customer Service ..... 8 Hours

Outcome: Communicate clearly with customers regarding the operation, service and repair of outdoor power equipment.

1. Identify the classes of customers encountered in the outdoor power equipment industry:

a) retail customers
b) wholesale customers
c) internal customers
d) primary contact customer service (face to face contact)
e) secondary contact customer (phone, fax, email, EDI etc)

2. Compare the differences, costs and benefits of retaining customer's vs. the costs and benefits of gaining new customers.

3. Identify effective techniques for dealing with difficult situations with customers:

a) angry customers
b) impatient customers
c) indecisive customers
d) other situations

4. Describe techniques for recovering 'lost' customers.

C. Work Orders ..... 6 Hours

Outcome: Be able to take and complete work orders for the repair and service of outdoor power equipment.

1. Describe the information required to complete a work order.
2. Complete the information required for a work order with a customer.
3. Enter work completed, parts installed comments etc. on work orders.
4. Prepare an estimate for repairs, service procedures, etc.
5. Complete an engine or equipment evaluation form.
6. Describe technician productivity and efficiency ratings.

SECTION SIX..... ASSEMBLY AND PRE-DELIVERY ..... 18 HOURS

A. Unloading and uncrating ..... 9 Hours

Outcome: Receiving, unload and uncrate power equipment

1. Describe the procedure for receiving goods
   a) Waybills, counts and inspections for shipping damage
   b) Noting damages, shortages,
   c) Liability of shipper, receiver, transport company
   d) Signing for goods received
2. Briefly describe the relationship between packing slips, purchase orders and invoices
3. Operate lifting and towing equipment to move outdoor power equipment in the shop and in the yard.
4. Describe forklift and lifting safety considerations
5. Describe fork lift accessories for power equipment.
6. Describe lifting and storing power equipment on racks or mezzanine.

B. Assembly PDI and storage ..... 9 Hours

Outcome: Uncrate, assemble and perform PDI for power equipment.

1. Uncrate and locate manufacturers assembly instructions:
   a) inspect
   b) ensure all parts are accounted for
   c) assemble according to instructions
   d) ensure cables, wires etc. are properly routed
   e) ensure all required fluids are at proper levels
   f) ensure batteries etc. are prepared for service if applicable
   g) adjust all belts, chains control cables, etc. as required
   h) ensure wheels steering etc. are properly installed, tightened, adjusted, as applicable
2. Perform PDI using manufacturer's checklist.
3. Describe repair procedures for minor cosmetic damage.
4. Describe the preparation of power equipment for long term storage, including the requirements for:
   a) cleaning
   b) batteries
   c) fuel, fuel tanks and fuel systems
   d) oil
   e) cooling systems
   f) fogging etc.

SECTION SEVEN ..... WHEELS TIRES AND BRAKES ..... 36 HOURS

A. Wheels and tires ..... 12 Hours

Outcome: Service wheels, remove and replace tires for outdoor power equipment.

1. Identify the types of wheels common to the outdoor power equipment industry.
2. Remove tube and tubeless tires on outdoor power equipment wheels.
3. Inspect wheels, tires rims for damage, defects, describe repair / replacement procedures.
4. Install tires and tubes if applicable.
5. Check and correct wheel balance.
6. Describe the industry conventions for labelling tire size and application.

7. Analyze tire tread wear patterns for alignment or balancing problems.
8. Locate and repair punctures in tubes and tires.
9. Describe the limitations of tire repairs.
10. Remove and replace wheel hubs.

B. Brakes ..... 24 Hours

Outcome: Inspect, remove, service and replace brakes.

1. Describe braking systems commonly found on outdoor power equipment:
   a) drum brakes
   b) disk brakes
   c) mechanical operation
   d) hydraulic operation
   e) electric brakes
   f) inboard brakes
   g) wheel mounted brakes
   h) jackshaft mounting
   i) other brakes (e.g. engine brake – blade brakes)
2. Describe brake operated steering
3. Describe hydraulic braking system.
4. Inspect brake fluid levels, bleed brake system, and maintain correct fluid levels.
5. Remove and replace brake shoes from a drum brake system.
6. Remove and replace brake pads from a disk brake system.
7. Evaluate condition of brake shoes, pads, drums and disks.
8. Remove disassemble, recondition and re-assemble master cylinder, slave cylinder, disk callipers.
9. Adjust mechanical linkages, cables, drum brake shoes etc.
10. Describe trailer brake operation:
    a) electric controllers – types, wiring and operation
    b) inertial controllers
    c) surge brakes
    d) electric over hydraulic
    e) breakaway system
11. Describe Alberta traffic safety requirements for trailer brakes on public highways.
12. Trouble shoot trailer brake system.

SECTION EIGHT..... CARBURETORS FUEL PUMPS AND FUEL .....24 HOURS

A. Fuels..... 2 Hours

Outcome: Describe the fuels used for outdoor power equipment.

1. Describe the characteristics of power equipment fuels, including:
   a) gasoline
   b) diesel
   c) LPG (propane)
   d) alcohol / gasohol
   e) kerosene

2. Describe quality and safety concerns for fuel storage including:
   a) gasoline
   b) diesel
   c) LPG (propane)
   d) alcohol / gasohol
   e) kerosene

3. Explain the requirements for fuel tanks, lines and filters for the following fuel types:
   a) gasoline
   b) diesel
   c) LPG (propane)
   d) alcohol / gasohol
   e) kerosene

4. Describe service procedures for high-pressure fuel delivery systems

5. Describe considerations for alcohol based fuels pertaining to:
   a) Water absorption
   b) Compatibility with components or materials found in some fuel delivery systems.

B. Fuel pumps tanks and lines ..... 6 Hours

Outcome: service small engine carburetor and fuel supply system.

1. Describe small engine fuel pumps, including:
   a) mechanical
   b) electrical
   c) pulsation

2. Describe fuel system tanks, tank mounting, fuel lines, and safety devices

3. Test, diagnose and troubleshoot small engine fuel delivery systems.

C. Carburetor ..... 16 Hours

Outcome: Service small engine carburetors

1. Explain how a small engine carburettor works, including:
   a) venturi
   b) jets and needles
   c) float
   d) throttle – air control
   e) idle, high speed and iow speed circuits
   f) cold start systems, chokes and enricheners

2. Identify and describe the common types of carburettor including:
   a) butterfly
   b) slide
   c) constant velocity
   d) diaphragm
   e) side draft up draft down draft

3. Dissemble evaluate condition and recondition small engine carburettor, set float, needle position etc.

SECTION NINE ..... ENGINES ..... 36 HOURS

A. Four stroke internal combustion theory ..... 15 Hours

Outcome: Describe the components and operation of small engines.

1. Describe the basic five stroke engines:
   a) intake, compression, combustion, exhaust.
   b) piston, connecting rod crankshaft
   c) crankcase, cylinder, cylinder head
   d) camshaft, lifters, valves
   e) sidevalve, overhead valve, overhead cam
2. Describe ignition timing for flywheel magneto ignition systems.
3. Disassemble a small four stroke engine.
4. Evaluate condition of valves, piston rings, cylinder, crankshaft, main, rod and small end bearings.
5. Reassemble engine, set valves, carburettor, timing, governor etc.

B. Two Stroke engines ..... 15 Hours

Outcome: Describe the components and operation of two stroke engines.

1. Describe two stroke engine design, including:
   a) two stroke operation
   b) pre mix fuel to oil ratios
   c) injector pumps
   d) piston port ed
   e) reed valve
   f) rotary valve
   g) variable exhaust port timing
   h) crankcase sealing
   i) built up crankshafts
   j) transfer ports
   k) loop charged
   l) deflector top pistons
   m) exhaust scavenging
2. Disassemble small two stroke engines.
3. Evaluate condition of piston rings, cylinder, and crankshaft assembly valves (if present).
4. Decarbonize if required.
5. Reassemble engine, set carburettor, timing, etc.

C. Governors ..... 6 Hours

Outcome: Service small engine governors.

1. Describe engine speed control for utility engines.
2. Describe air vane and mechanical governors.
3. Adjust engine governor for no load rpm and load rpm.

SECOND PERIOD TECHNICAL TRAINING
OUTDOOR POWER EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:.....FRAMES AND SUSPENSIONS.....14 HOURS

A. Frame Types and Materials ..... 2 Hours

Outcome:

1. Identify the types of frames and materials used for outdoor power equipment, wheeled vehicles, wheeled equipment, tracked vehicles, and trailers:
   a) ferrous and non ferrous alloys
   b) tubing
   c) castings
   d) fabricated sheet.
2. Describe the function of frames and frame components for:
   a) wheeled utility vehicles and golf carts
   b) snowmobiles – tracked vehicles
   c) trailers
   d) other wheeled equipment
   e) stationary and portable equipment
3. Identify frame damage and describe repair / replacement options.

B. Suspension..... 6 Hours

Outcome: Service and repair steering linkages.

1. Identify front and rear suspension types.
2. Describe the purpose of suspensions.
3. Describe sprung and unsprung weight.
4. Describe solid axle and independent suspensions.
5. Describe spring construction:
   a) coil
   b) leaf
   c) torsion
   d) air.
   e) describe shock absorber operation.

C. Steering Systems ..... 6 Hours

Outcome: Service outdoor power equipment steering systems.

1. Describe steering linkages and components for:
   a) snowmobiles
   b) all terrain utility vehicles
   c) golf carts
   d) lawn tractors
   e) other equipment
2. Identify steering linkage types and explain their operation.

3. Describe the following steering adjustments:
   a) caster
   b) camber
   c) toe in/out
4. Adjust steering to specifications for the following as applicable:
   a) caster
   b) camber
   c) toe in/out

SECTION TWO: ..... FUEL SYSTEMS ..... 36 HOURS

A. Induction Systems ..... 6 Hours

Outcome: Service outdoor power equipment air intake systems.

1. Describe the characteristics of the following air filters:
   a) paper
   b) foam
   c) oil bath
   d) mesh – other
2. Describe naturally aspirated intake systems.
3. Describe the effect of intake length in relation to engine performance and design.
4. Describe the purpose and design features of intake manifolds.
5. Describe forced air induction:
   a) turbo chargers
   b) super chargers.
6. Service air cleaners and intake system components.

B. Electronic Fuel Injections ..... 18 Hours

Outcome: Service outdoor power equipment EFI systems.

1. Describe the basic principles of electronic fuel injection including:
   a) basic components common to EFI systems.
   b) multiport vs. single point delivery.
2. Explain the speed density and mass air flow of air measurement and identify the fuel injection system where each is used.
3. Explain purpose operation and location of fuel injectors.
4. Explain how air fuel mixtures are altered for various engine operating conditions.
5. Explain purpose, construction, location and operation of various air mass measuring devices.
6. Identify and describe the following fuel injection system types:
   a) Ficht
   b) Orbitol
   c) HPDI.
   d) E tech
7. Diagnose EFI systems as applicable:
   a) OEM error codes
   b) scan tools
   c) standard electrical test equipment (VOMs test lights etc.)
   d) built in OEM scan tests

8. Test system pressure, operation of fuel delivery system.

C. Diesel ..... 12 Hours

Outcome: Service compression ignition fuel systems used in outdoor power equipment.

1. Describe the diesel combustion process.
2. Describe the operation of glow plugs and preheaters.
3. Describe the fundamental operation and design features of diesel fuel injection systems and related components:
   a) lines and fittings
   b) filters
   c) pumps.
4. Describe the diesel injector.
5. Remove test and install diesel fuel injectors.
6. Remove air trapped in a diesel fuel system.
7. Remove, inspect, install and time diesel injector pump.

SECTION THREE: ..... SPARK IGNITION SYSTEMS ..... 28 HOURS

A. Magneto Ignition ..... 10 Hours

Outcome: Service magneto ignition systems

1. Describe how a magneto ignition system works.
2. Describe how a CDI magneto works.
3. Identify the components of the magneto ignition system.
4. Describe how a timed spark is produced by a magneto:
   a) points system
   b) solid state system.
5. Test magneto operation.
6. Inspect, recondition, replace, and adjust, magneto components.

B. Mechanical and Electronic Ignition Systems Low and High Tension Circuits ..... 12 Hours

Outcome: Service ignition circuits

1. Describe the operation of a inductive coil ignition system.
2. Describe methods for controlling ignition timing:
   a) points
   b) electronic/breaker less
   c) engine management systems
3. Describe the purpose of spark advance.
4. Describe methods of producing spark advance:
   a) mechanical
   b) electronic
   c) engine management system
5. Describe the components of the high voltage circuit:
   a) coils
   b) high tension leads
   c) distributor and components

6. Describe spark plug construction.
7. Describe and identify spark plug heat range.

C. Ignition Start and Interlock, Service ..... 6 Hours

Outcome: Service and troubleshoot ignition and interlock systems.

1. Describe ignitions and starting systems interlocks:
   a) mechanical
   b) electrical
2. Test and repair ignitions systems and interlocks.
3. Describe legal and liability issues of disabling or modifying interlock systems.
4. Service and trouble shoot ignition components:
   a) spark plugs
   b) distributors
   c) points
   d) pickup/sensors
   e) coils
   f) modules
   g) connections, wiring.
5. Troubleshoot an ignition system, identify and correct no spark condition.

SECTION FOUR: ..... CHARGING SYSTEMS ..... 20 HOURS

A. Alternators ..... 20 Hours

Outcome: Service alternators and generators.

1. Describe how electricity is generated by an alternator and a generator:
   a) permanent magnet single phrase
   b) permanent magnet three phrase
   c) electromagnetic rotor three phase
2. Describe voltage regulation systems.
3. Identify the components and location of components of a charging system.
4. Perform tests on charging system including the following components:
   a) stator
   b) rotor
   c) rectifier assembly
   d) slip ring and brushes
   e) regulators
   f) integrated charging system control modules.
5. Service alternator and generator drive systems (belts, mounts etc.)
6. Test charging systems for output voltage and amperage.
7. Troubleshoot faults and assess need to replace or overhaul alternators or components.
8. Identify outputs, open and short circuits, grounding in wiring.

SECTION FIVE: ..... STARTING SYSTEMS ..... 30 HOURS

A. Starters ..... 30 Hours

Outcome: Service outdoor power equipment starter systems.

1. Describe outdoor power equipment manual start systems.
2. Disassemble; inspect, clean, repair-replace components as required, install recoil starters.
3. Describe outdoor power equipment electric start systems:
   a) battery operated electric start
   b) 110 volts (line voltage) electric start.
   c) combination starter generator systems
4. Describe starter drives.
5. Describe the components found in electric starter circuits:
   a) key, ignition switch
   b) interlocks
   c) relay
   d) solenoid
   e) ignition by-pass.
   f) battery cables
6. Remove, inspect and replace electric start motors, relays solenoids (if applicable).
7. Troubleshoot electric starting systems, include the following tests or procedures:
   a) amp draw
   b) voltage drop
   c) rpm
   d) operation of switches, solenoids, automated systems.

SECTION SIX: ..... EXHAUST SYSTEMS..... 12 HOURS

A. Exhaust systems ..... 6 Hours

Outcome: Service exhaust and systems.

1. Describe the purpose and function of an exhaust system.
2. Describe outdoor power equipment exhaust noise control, including legal or liability concerns.
3. Describe how engine sound levels are measured.
4. Describe two cycle exhaust systems, tuned exhausts / expansion chambers.
5. Describe four cycle exhaust systems:
   a) dry
   b) wet
6. Remove and replace exhaust systems and exhaust system components.
7. Inspect and correct exhaust system components for:
   a) damage – leaks - corrosion
   b) carbon build up
   c) malfunction (muffler – catalytic converters)
   d) functioning heat shields spark arrestors etc.

B. Emission control ..... 6 Hours

Outcome: Service emission control systems.

1. Describe the Canadian and Alberta legal requirements for emission control for outdoor power equipment.
2. Explain the trend towards tightened emission control laws for outdoor power equipment.
3. Describe exhaust emission control devices:
   a) pvc systems
   b) catalytic converters

c) spark arrestors
d) engine management systems
e) other emission control devices

4. Use an exhaust gas analyzer to measure exhaust gas on outdoor power equipment how engine emissions are measured.

SECTION SEVEN: .....COOLING SYSTEMS.....18 HOURS

A. Air Cooling.....2 Hours

Outcome: Evaluate and service air cooling systems and components of outdoor power equipment.

1. Describe principles of heat transfer.
2. Describe air-cooling systems including:
   a) engine finning
   b) fans and shrouding
3. Service air cooling components including:
   a) fins
   b) fans
   c) air shrouding and components

B. Liquid Cooling.....10 Hours

Outcome: Service liquid cooling systems and components.

1. Describe liquid cooling systems including:
   a) principle of operation
   b) radiator operation – construction materials
   c) coolants, mixing ratios, corrosion and inhibitors
   d) thermostats
   e) water pumps
   f) fans, direct drive, thermostatic and electric
2. Inspect, troubleshoot, replace or repair, liquid cooling components including:
   a) pressure
   b) thermostat operation
   c) flush and refill
   d) water pump operation
   e) condition of hoses and or passageways

C. Oil Cooling.....6 Hours

Outcome: Service liquid cooling systems and components.

1. Describe oil cooling / heat exchangers and their applications including:
   a) engine oil cooler
   b) transmission oil cooler
   c) power steering or hydraulic oil cooler
   d) external lines and fittings.
2. Inspect, replace or repair oil cooling components

SECTION EIGHT: .....LUBRICATION SYSTEMS.....12 HOURS

A. Oils .....1 Hour

Outcome: Describe the need for lubrication, properties of lubricants, lubrication systems used for outdoor power equipment.

1. Describe lubrication and the role of oil in cooling and the removal of wear particles.
2. Describe the lubrication requirements of bearings, gears, and sliding parts including:
3. Plain bearings.
4. Roller, ball and needle bearings.
5. Gear teeth.
6. Pistons, cylinders.
7. List and briefly describe power equipment lubrication requirements including:
   a) two stroke crankcase induction engines
   b) four stroke engines
   c) transmissions/gear cases/differentials
   d) suspensions
   e) drive components
   f) auxiliary drive components
   g) cables control rods etc.
8. Identify types and grades of oils, greases, other lubricants by – API and SAE classification.
9. Describe the meaning of viscosity ratings and oil service conditions and classifications.

B. Oil Pumps .....6 Hours

Outcome: Service oil pumps.

1. Identify and the following oil circulation systems:
   a) splash
   b) gear
   c) piston
   d) trochoid.
2. Distinguish between wet and dry sump lubrication systems.
3. Describe oil pressure requirements for engine components:
   a) plain bearing
   b) frictionless bearing
   c) sliding parts
   d) high load vs. low load.
4. Remove, inspect, recondition or replace oil pumps.
5. Test oil pressure.
6. Explain how oil pressure can be used to diagnose engine condition.

C. Filtration Systems ..... 1 Hour

Outcome: Service oil pumps and lines.

1. Describe the operation of oil filters including:
   a) full and partial flow
   b) bypass system
   c) element construction
   d) centrifugal.
2. Locate, remove replace or clean the following filter types:
   a) removable - disposable
   b) centrifugal
   c) magnetic drain plug, other.

D. Lubrication Circuits ..... 1 Hour

Outcome: Service lubrication lines, passages and seals.

1. Identify and service the following lubrication circuit components:
   a) relief valves
   b) bypass valves
   c) metering orifices.
   d) oil lines
2. Describe oil pressure monitoring systems:
   a) direct pressure gage
   b) electrical sensors
   c) pressure warning light
   d) electrical pressure gage
   e) other indicators of oil pressure problems
3. Examine, evaluate condition, service internal and external oil lines passages seals etc.
4. Remove and replace oil pressure sensors ndicators and valves.

E. Two-stroke Lubrication..... 3 Hours

Outcome: Service two stroke lubrication systems.

1. Describe two-stroke lubrication:
   a) premix ratios
   b) injector systems
   c) injector pump operation and adjustment.

SECTION NINE:..... TUNE-UP AND TROUBLESHOOTING ..... 70 HOURS

A. Tune up and troubleshooting..... 55 Hours

Evaluate condition of engines and do a tune up.

1. Describe the three requirements for engine operation:
   a) compression
   b) fuel
   c) ignition.
2. Perform visual inspection of engine assess for signs of damage, wear, leakage etc.

3. Examine spark plugs and assess the following by reading spark plugs:
   a) carburetion
   b) oil consumption
   c) overheating
   d) detonation – pre-ignition
   e) engine/cylinder operating properly.
4. Explain how compression test data can be used to determine the condition of cylinders, rings, valves, pistons, etc.
5. Perform wet and dry compression tests using a compression tester to make a preliminary diagnosis of engine component condition.
6. Describe other methods for testing compression (eg engine analyzers etc.)
7. Perform a leak down test and use the test results to diagnose engine component condition.
8. For an engine that has compression, fuel system and ignition within acceptable limits, check and adjust where appropriate:
   a) ignition timing
   b) carburetor settings
   c) engine idle speed.
   d) governor settings
   e) control linkages
   f) sensor condition, operation where applicable.
9. For an engine that will not run, verify compression, fuel and ignition.
10. For a non-running engine or poorly running engine where the fault has been isolated to ignition or carburetion, make required repair or replacement.
11. For an engine where a compression, fuel or ignition problem has been isolated, use a systematic approach to identify and describe the fault.

B. Engine management systems ..... 15 Hours

Outcome: Service comprehensive engine management systems.

1. Describe how an integrated electronic engine management system can control EFI, ignition advance, charging systems. Emission controls, interlock systems, engine RPM, cooling and monitor lubrication systems.
2. Obtain engine management system trouble codes.
3. Use trouble codes to find and correct fault conditions.

THIRD PERIOD TECHNICAL TRAINING
OUTDOOR POWER EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... HYDRAULICS .....80 HOURS

A. Hydraulic Basics ..... 6 Hours

Outcome: Describe basic hydraulic principles.

1. State the safety precautions that must be observed when working with hydraulics
2. Explain hydraulic principles of pressure, force, area, volume, power, and flow rate cycle times using mathematical calculations.
3. Draw and interpret basic hydraulic schematics.
4. Describe the operation of closed loop and open loop hydraulic systems as found in outdoor power equipment.
5. Identify the components found in open loop and closed loop hydraulic systems.

B. Pumps and Motors ..... 12 Hours

Outcome: Service hydraulic pumps and motors.

1. Explain basic hydraulic principles related to hydraulic pumps.
2. Explain the principles of operation and application of a typical gear pump.
3. Explain the principles of operation and application of a typical piston type hydraulic pump.
4. Explain the principles of operation and application of a typical vane pump.
5. Explain the principle of gear, vane and piston hydraulic motors.
6. Explain the operation and application of a typical gear, vane, and piston hydraulic motors.
7. Remove, disassemble, inspect, reseal, repair, and replace components of hydraulic motors

C. Cylinders ..... 12 Hours

Outcome: Service hydraulic cylinders.

1. Explain the operation and applications of basic hydraulic cylinders:
   a) double acting
   b) single acting
   c) balanced
   d) unbalanced
2. Dismantle, inspect, reseal, and re-assemble hydraulic cylinders.

D. Lines ..... 1 Hour

Outcome: Service hydraulic lines.

1. Describe hydraulic lines fittings and couplers.
2. Perform visual inspection of lines, fittings, and couplers.
3. Describe pressure ratings and classifications of lines fittings and couplers.
4. Identify high pressure and low-pressure lines fittings and couplers.

E. Hydraulic Fluids ..... 1 Hour

Outcome: Describe hydraulic fluid properties, filtration and cooling.

1. Explain properties of hydraulic fluid and criteria of its selection.
2. State the functions of the hydraulic reservoir and its related components.
3. State the function and principles of operation of filtration devices.
4. State the function and application of hydraulic heat exchangers.

F. Control Valves ..... 2 Hours

Outcome: Service hydraulic control valves

1. Explain the principles and applications of basic hydraulic control valves:
   a) spool valve
   b) check valve
   c) shuttle valve
   d) manual valve

G. Pressure Valves ..... 2 Hours

Outcome: Describe hydraulic pressure valves

1. State the function and principles of operation of:
   a) direct acting pressure valve
   b) pilot control valves.

H. Fluid Drives ..... 3 Hours

Outcome: Service fluid drives

1. Define fluid drives.
2. Explain function and operating principles.
3. Describe the components of a fluid drive
4. Disassemble and assemble basic fluid drive.

I. Testing ..... 41 Hours

Outcome: Troubleshoot hydraulic systems

1. Use a systematic procedure to diagnose common faults in a simple hydraulic system.
2. Identify the cause and common failures of hydraulic system components.
3. Assess performance and troubleshoot components of a basic hydraulic system.
4. Use systematic procedures to diagnose common faults.
5. Test a complete hydraulic system.

SECTION TWO: ..... BASIC DRIVES ..... 60 HOURS

A. Gear and Drive Ratios ..... 3 Hours

Outcome: Given diameters or number of gear teeth, calculate gear and drive ratios.

1. Explain the need for reduction ratios in terms of the relationship of torque and power.
2. Calculate gear sprocket and pulley ratios.
3. Describe the effect on rotation of selecting gears or sprockets and pulleys to transmit rotary motion.

B. Belt Drives ..... 3 Hours

Outcome: Service belt drive systems.

1. Describe belt drive systems found in power equipment:
   a) construction
   b) sizing
   c) application.
   d) V belts
   e) Toothed belts
   f) belt drive CVTs
2. Inspect, adjust, align and tension a belt drive.
3. Inspect evaluate and replace pulley system if required
4. Diagnose belt drive failures.

C. Chain Drives ..... 4 Hours

Outcome: Service chain drive systems.

1. Describe the chain drive types found in power equipment:
2. Roller.
3. O ring roller.
4. Hyvo (silent).
5. Describe chain and sprocket sizing convention.
6. Describe lubrication requirements for each chain type.
7. Describe chain connectors, riveted and master links and chain breakers.
8. Chain drive CVT.
9. Evaluate condition, remove and replace chains and sprockets.
10. Adjust chain for tension and alignment.

D. Clutches ..... 21 Hours

Outcome: Service clutches.

1. Explain operation and principles of a clutch.
2. Explain the construction, design features and function of a single and multiplate clutch.
3. Describe the operation of an electromagnetic clutch.
4. Disassemble, inspect and reassemble electric clutches.
5. Describe the operation of a centrifugal clutch.

6. Describe the operation of a variable ratio clutch including:
   a) principles of operation
   b) torque multiplication.
7. Describe clutch actuation for outdoor power equipment:
   a) mechanical
   b) hydraulic
   c) electric
   d) automatic
   e) other
8. Diagnose problems related to clutch assembly.
9. Disassemble inspect, and re-assemble clutches:
   a) multiplate
   b) single plate
10. Disassemble inspect and reassemble a centrifugal clutch.
11. Disassemble, inspect and reassemble a variable ratio clutch.
12. Adjust a clutch assembly.
13. Adjust clutch actuator (if applicable)

E. Transmissions ..... **21 Hours**

Outcome: Service transmissions.

1. Define gear terminology.
2. Identify the gear types found in power equipment and describe their applications.
3. Identify gear tooth types and applications.
4. Describe gear tooth contact patterns.
5. Describe shift mechanisms:
   a) synchromesh and non synchromesh
   b) constant mesh.
6. Describe shift selection types:
   a) linear
   b) non linear
   c) selector forks
   d) rotary selection
   e) gear dogs.
7. Disassemble inspect and re-assemble a basic transmission.

F. Differentials ..... **6 Hours**

Outcome: Service differentials

1. Describe the purpose and function of differentials.
2. Explain differential operations.
3. List differential components.
4. Inspect and adjust differential.

G. Drive Shafts and Universal Joints ..... 2 Hours

Outcome: Service drive shafts and universal joints

1. List drive shaft and PTO types and their components.
2. Service and repair drive shaft assemblies.
3. State the function of universal joints.
4. Identify the parts of a universal joint.
5. List types of PTO power transmitting devices.
6. Distinguish between types of PTO shafts.
7. Describe the operation of the universal joint and the constant velocity universal joint.
8. Diagnose and repair driveline vibration problems.
9. Disassemble, inspect, and service a single carbon type universal joint.

SECTION THREE: ..... ENGINE OVERHAULS ..... 90 HOURS

A. Engine Failures ..... 2 Hours

Outcome: Diagnose an engine failure and explain why the engine failed.

1. Diagnose engine failures including but not restricted to:
   a) operator interview
   b) visual inspection
   c) compression tests
   d) leak down tests
   e) mechanical inspections
   f) determine cause
2. Prepare estimates of parts, labour and sublet repairs, where applicable, prepare repair options for customer.

B. Measurement and Inspection ..... 30 Hours

Outcome: Use precision measuring tools to inspect and evaluate internal engine wear/condition.

1. Disassemble engine, inspect and measure the following components to factory wear specifications:
   a) cylinder
   b) crank shaft
   c) piston
   d) rings.
   e) head and valve train
   f) connecting rod
   g) bearings.

C. Recondition Parts ..... 20 Hours

Outcome: Recondition serviceable engine components.

1. Describe the purpose of factory specified operating clearances for the following components:
   a) cylinders.
   b) crankshaft
   c) pistons and rings.
   d) heads and valve train.
   e) connecting rod
   f) bearings

2. Describe how engine design and purpose effects specified clearances.
3. Describe total allowable wear limits.
4. Describe economic considerations for replacing worn components with new parts, reconditioned parts, reconditioning the parts in the shop, or replacement with a new unit.
5. Perform the following reconditioning procedures for applicable engine type where the procedure is appropriate:
   a) hone cylinder
   b) check and adjust piston ring end gap
   c) grind and lap valve
   d) replace valve seat
   e) cut valve seat
   f) resize connecting rod
   g) surface a head.
6. Describe piston knurling.

D. Reassembly of Engines ..... 35 Hours

Outcome: Assemble engines according to specifications.

1. Re-assemble engine.
2. Describe why cleanliness is essential for reassembly.
3. Fit Pistons and rings, hone cylinders.
4. Describe the purpose of assembly clearance and why clearances might vary for different engine types or manufacturers.
5. Assemble Cranks and connecting rods, check for proper clearance and fit.
6. Plain insert bearing bottom end type.
7. Inspect new roller bearing bottom end for fit and clearance.
8. Assemble valves springs and spring keepers, assemble valve train.
9. Replace -reassemble seals and O-rings.
10. Perform final assembly of engine and related components, lubricants and coolants initial adjustments, as required.

E. Testing of Rebuilt Engine and Final Adjustments ..... 3 Hours

Outcome: Perform an initial running in and evaluation of a reconditioned engine..

1. Do an inspection and start up of newly assembled engine.
2. Perform running adjustments, synchronization.
3. Test and evaluate the newly assembled engine under operating conditions or an adequate simulation.

SECTION FOUR ..... ADVISORY NETWORK AND COACHING SKILLS ..... 10 HOURS

A. Advisory Network And Coaching Skills ..... 10 Hours

Outcome: Describe the importance of the apprenticeship advisory network; describe the use of coaching skills to train apprentices on the job.

1. Describe the following coaching skills used for training apprentices:
   a) identify the point of lesson
   b) link the lesson
   c) demonstrate a skill
   d) provide opportunity to practice a skill
   e) give feedback to learner
   f) assess the learner's progress.

2. Describe the role and purpose of the advisory network and the Provincial apprenticeship Committee for the Outdoor Power Equipment Technician trade.

   a) promote apprenticeship training

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SECTION ONE ..... FUEL SYSTEMS ..... 30 HOURS

A. Marine Fuel Systems ..... 1 Hour

Outcome: Describe the fuel systems for marine equipment

1. Describe marine fuel supply systems.
2. Describe safety issues for marine fuel systems.
3. Describe bilge venting systems.
4. Describe anti siphon valves.
5. Test marine fuel system operation:
   a) vacuum
   b) pressure
   c) air leak test.
   d) Describe marine fuel pumps.

B. Advanced Carburetion ..... 2 Hours

Outcome: Describe high performance carburetion for outdoor power equipment

1. Describe typical ATV marine and snowmobile carburetors.
2. Describe constant velocity (CV) carburetors.
3. Compare CV carburetor operation to conventional slide carburetor operation.
4. Describe the following carburetor types:
   a) Rochester and Holley two barrel
   b) Rochester, Weber and Holley four barrel.
   c) Describe outboard proprietary butterfly carburetors.

C. Carburetor Troubleshooting ..... 10 Hours

Outcome: Troubleshoot carburetor and fuel mixture faults

1. Describe how carburetor faults are isolated.
2. Describe how a carburetor fault is determined and the steps required to solve the problem including:
3. Adjust and troubleshoot:
   a) Holley and Rochester two barrel
   b) Holley Rochester and Weber four barrel
   c) Mikuni round slide, flat slide, CV, butterfly Super BM
   d) Keihin round slide, flat side, CV, butterfly
   e) Proprietary outboard butterfly.
4. Synchronize multiple carburetors using various techniques.

D. Jetting Principles ..... 2 Hour

Outcome: Modify carburetor jetting to alter engine performance

1. Describe why jetting modifications are made.
2. Describe the procedure for making and evaluating changes to jetting.
3. Describe initial carburetor set up:
   a) new OEM replacement or rebuilt or serviced carburetor set up
   b) non OEM replacement type set up
   c) new OEM different carburetor type set up.
4. Describe how to evaluate initial settings and make adjustments for optimal performance:
   a) piston wash
   b) plug reading.
5. Describe function and installation of a pyrometer.
6. Describe how to use pyrometer readings to evaluate jetting.
7. Describe Dial A Jet / Power Jet function and installation.
8. Describe altitude compensators and DPM.
9. Troubleshoot altitude compensator and DPM.

E. Oil Injection ..... 3 Hours

Outcome: Troubleshoot oil injection systems

1. Trouble shoot disassemble, assemble, set up and test oil injection system:
   a) Mikuni
   b) VRO.

F. Advanced Fuel Injection ..... 12 Hours

Outcome: Troubleshoot EFI systems

1. Describe:
   a) lift pumps
   b) vapour separators
   c) high pressure pumps
   d) regulators
   e) battery-less fuel injection systems.
2. Test and troubleshoot:
   a) outboard EFI
   b) direct injection
   c) recreation EFI
   d) testing /troubleshooting
   e) stern drive EFI.

SECTION TWO ..... IGNITION SYSTEMS ..... 25 HOURS

A. Marine And Recreation Ignition Systems ..... 25 Hours

Outcome: Describe the fuel systems for marine equipment

1. Describe Marine and Recreation ignition system considerations:
   a) electronic reverse
   b) idle stabilizers
   c) high speed spark advancers
   d) ois
   e) cdm ignition
   f) engine protection systems
   g) digitally controlled ignition
   h) other.
2. Test and troubleshoot Marine and Recreation ignition components:
   a) electronic reverse
   b) idle stabilizers
   c) high speed spark advancers
   d) OIS
   e) CDM ignition
   f) engine protection systems
   g) digitally controlled ignition
   h) other.
3. Adjust digital (programmable) timing.
4. Describe throttle safety switches.
5. Describe digital keyless security systems.
6. Test and adjust throttle safety switch.
7. Program digital key.
8. Troubleshoot digital keyless system.
9. Describe stern drive distributor and distributor-less ignition systems.
10. Troubleshoot test and adjust stern drive ignition systems.

SECTION THREE ..... MARINE GEAR HOUSINGS ..... 25 HOURS

A. Shifting ..... 2 Hours

Outcome: Service marine transmissions and clutches

1. Describe various marine shift mechanisms:
   a) electric shift
   b) mechanical shift
   c) cone clutch
   d) adjust shift mechanisms.

B. Shimming ..... **20 Hours**

Outcome: Perform marine shimming

1. Describe marine shimming procedures:
   a) pinion height
   b) forward gear lash
   c) reverse gear lash
   d) end float.
2. Perform marine shimming procedure on various gear housings.

C. Transom Plates ..... **3 Hours**

Outcome: Service transom plates

1. Describe transom plate service procedures:
   a) alignment
   b) drive installation.

SECTION FOUR ..... **JET DRIVES** ..... **10 HOURS**

A. Pumps ..... **2 Hours**

Outcome: Describe jet drive systems

1. Describe pump types:
   a) mixed flow
   b) axial flow
   c) outboard pumps.
2. Describe jet drive components:
   a) intake grate
   b) impeller
   c) wear ring
   d) stator
   e) nozzle.

B. Jet Drive Maintenance ..... **8 Hours**

Outcome: Service jet drives

1. Perform maintenance and adjustment:
   a) impeller clearance
   b) shift mechanism
   c) bearings
   d) alignment
   e) troubleshooting.
2. Describe jet drive performance accessories:
   a) grates
   b) impellers
   c) trim.
3. Install and troubleshoot jet drive performance accessories.

SECTION FIVE ..... POWER TRIM ..... 20 HOURS

A. Power Trim ..... 20 Hours

Outcome: Service power trim systems

1. Describe trim limit methods.
2. Troubleshoot trim limit.
3. Describe power trim components used by various manufacturers.
4. Describe Marine power trim operation.
5. Test and Troubleshoot Marine power trim systems.

SECTION SIX ..... PROPS AND HULLS ..... 10 HOURS

A. Props ..... 6 Hours

Outcome: Troubleshoot propeller performance

1. Describe prop characteristics and operation:
   a) pitch
   b) diameter
   c) rake
   d) cupping
   e) slip.
2. Describe materials used for props:
   a) aluminum
   b) steel
   c) brass/bronze
   d) composite
3. Describe prop design:
   a) number of blades
   b) blade shape
   c) blade size
   d) hub type.
4. Describe prop troubleshooting:
   a) cavitation
   b) ventilation
   c) slip calculation
   d) speed calculation.

B. Hulls ..... 4 Hours

Outcome: Describe hull characteristics

1. Describe hull design and terminology:
   a) transom angles
   b) bottom configuration
   c) materials.

2. Describe handling problems:
   a) hull defects
   b) engine height
   c) torque problems
   d) speed loss.

SECTION SEVEN ..... RECREATION DRIVE TRAINS ..... 30 HOURS

A. Recreational Clutches ..... 20 Hours

Outcome: Service recreational equipment drivelines

1. Describe relationship between clutch adjustment, horsepower and torque.
2. Describe centrifugal clutch parts and function.
3. Adjust or alter clutch components to optimize performance:
4. Perform clutch alignments:
   a) center to center
   b) alignment or skew
   c) offset
   d) belt deflection.
5. Describe drive belt selection.
6. Perform drive belt failure analysis.

B. Tracks ..... 2 Hours

Outcome: Select and service snowmobile tracks

1. Describe snowmobile track types and sizes.
2. Perform track service and maintenance:
   a) alignment
   b) tension
   c) clip replacement
3. troubleshoot tracks and components
4. Describe track selection for specific applications.
5. Describe accessory or replacement track types and modifications:
   a) types and profiles
   b) pitch and driver styles
   c) traction aids
   d) stud types
   e) cleats and claws
   f) paddles
   g) installation and clearances.

C. Driveline ..... 8 Hours

Outcome: Service snowmobile drivelines

1. Describe the relationship between chaincase ratio driver size, and track configuration:
   a) gear ratios
   b) drivers
   c) track clearance
   d) angle of attack.

2. Remove and replace drive shaft.
3. Remove, replace and recondition chain case.

SECTION EIGHT..... STEERING AND SUSPENSION .....20 HOURS

A. Steering .....5 Hours

Outcome: Service snowmobile and recreational equipment steering systems

1. Describe recreational vehicle suspension systems:
   a) steering angles
   b) caster
   c) camber
   d) scrub
   e) bump steer
   f) skid steering
   g) alignment procedures.
2. Perform steering alignment.
3. Describe skis, ski types and wear rods.

B. Shocks .....5 Hours

Outcome: Service and rebuild schock absorbers

1. Perform shock absorber service:
   a) rebuild shock
   b) re-valve shock.

C. Front Suspension.....5 Hours

Outcome: Service front suspension components

1. Describe recreation front suspension:
   a) leaf spring
   b) A arm
   c) ball joints
   d) trailing arm
   e) telescopic strut
   f) torsion and sway bars.

D. Rear Suspension.....5 Hours

Outcome: Service rear suspension components

1. Describe recreation rear suspension:
   a) slider
   b) bogie
   c) linked or coupled
   d) rising / progressive rate.
2. Describe torque reaction and weight transfer.
3. Perform front and rear suspension adjustments:
   a) weight transfer rods / stops
   b) ride height
   c) spring preload.

2. SECTION NINE.....ACCESSORIES AND PERFORMANCE MODIFICATION .....10 HOURS

A. Electrical Accessories .....1 Hour

Outcome: ***Install and service electrical accessories***

1. Describe typical dealer installed electrical accessories:
   a) wiring procedures
   b) battery systems
   c) heated grips
   d) lights and horns
   e) depth and fishfinders
   f) radios
   g) electric winches
   h) alternator output.

B. Engine Accessories ..... 5 Hours

Outcome: ***Install engine accessories, modify engine performance***

1. Describe other engine accessories:
   a) reeds
   b) lightened components, flywheel etc.
   c) air intake components
   d) turbocharger / supercharger
   e) other.
2. Describe performance enhancing exhaust systems.
3. Describe how managing exhaust flow can improve volumetric efficiency of an engine, including trade offs such as trade offs between peak power and flexible power, noise issues, etc.
4. Describe the effect of exhaust tuning on horsepower curves.
5. Describe the two-stroke performance enhancing exhaust system:
   a) tuned pipe
   b) expansion chamber
   c) stingers
   d) expansion chamber mufflers
   e) effects of pipe temperature.
   f) Four stroke pipe tuning:
   g) effect of length on power at specific engine rpm
   h) one into one tuned pipe systems
   i) multi cylinder tuned pipe configurations
   j) mufflers and spark arrestors.
6. Describe the use of a pyrometer in monitoring engine efficiency and performance:
   a) types
   b) installation
   c) location
   d) effect on temperature with location.

C. Hull Accessories .....3 Hours

Outcome: ***Install marine hull accessories***

1. Describe the installation considerations for the various hull accessories:
   a) transom jacks
   b) set back plates

c) trim tabs
d) ski bars
e) downriggers
f) swim platform / ladders
g) steering and control systems
h) other.

D. Trailer Accessories ..... 1 Hour

Outcome: ***Install trailer accessories***

1. Describe trailer accessories:
   a) electric winches
   b) truck decks.

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SECTION ONE..... ADVANCED FUEL SYSTEMS .....25 HOURS

A. Power and Turf Equipment EFI and Sensor Servicing ..... 10 Hours

Outcome: Service power equipment engine management systems.

1. Set up, test and adjust throttle position indicator.
2. Check and test EFI and ECU sensors:
3. voltage output tests
4. resistance tests
5. Check and test all temperature sensors.
6. Locate and test oxygen sensor.
7. Locate and test knock or vibration sensors.
8. Test voltage and resistance of the map sensor.
9. Perform diagnosis of malfunction indicator light fault codes.
10. Perform model specific diagnostics of sensors using laptops, hand held testers; break out boxes, etc. as required.

B. Liquid Propane Gas ..... 3 Hours

Outcome: Install and maintain LPG fuel systems.

1. Describe characteristics of liquid propane gas.
2. Describe LPG operating Principles.
3. Describe unique components required to operate with LPG fuels.
4. Perform diagnosis and troubleshoot LPG systems.
5. Perform adjustments on LPG systems.
6. Describe safety, legal and gas codes related to LPG systems.
7. Describe modifications required in converting an engine to LPG operation.

C. Kerosene ..... 1 Hour

Outcome: Describe kerosene fueled equipment.

1. Describe characteristics of kerosene.
2. Describe operating principles of kerosene fuelled systems.
3. Describe components required for operating with kerosene fuel.
4. Describe mixture re-adjustment requirements for kerosene fuelled engines.

D. Diesel ..... 11 Hours

Outcome: Service diesel fuel systems.

1. Describe a diesel high-pressure fuel system.

2. Perform model specific pump timing procedures.
3. Perform system troubleshooting:
   a) over fueling (rich)
   b) lean mixture
4. Perform cylinder cancellation test.

SECTION TWO ..... ADVANCED TRANSMISSIONS ..... 25 HOURS

A. Transaxles ..... 6 Hours

Outcome: Service transaxles.

1. Identify transaxles common to power and turf equipment.
2. Describe transaxle service and repair.
3. Identify the cause of gear failure.
4. Perform overhaul of typical transaxle, repair and replace failed or worn components.

B. Shift Mechanisms ..... 1 Hour

Outcome: Service shift mechanisms.

1. Describe power and turf shift mechanisms.
2. Diagnose and troubleshoot shifting problems.

C. PTO Drives ..... 2 Hours

Outcome: Service Power Take Off systems.

1. Describe PTO operation.
2. Remove and replace various types of PTO common to turf and power equipment.
3. Diagnose PTO failure.
4. Set up and adjust PTO mechanism.

D. Final Drives ..... 6 Hours

Outcome: Service final drive systems.

1. Describe operation of the following drive types:
   a) worm gears
   b) disc drive
   c) chain and sprocket
   d) variable ratio clutch
   e) four wheel clutching systems.
   f) Diagnose and troubleshoot the following drive types:
   g) worm gears
   h) disc drive
   i) chain and sprocket
   j) variable ratio clutch
   k) four wheel clutching systems.
   l) Service and adjust the following drive types:
   m) worm gears
   n) disc drive
   o) chain and sprocket
   p) variable ratio clutch

q) four wheel clutching systems.

E. Hydrostatic Drives ..... 10 Hours

Outcome: Service hydrostatic drive systems.

1. Describe operation and placement of hydrostatic drive components.
2. Describe priority operation and sequencing of hydrostatic drive components.
3. Describe and practice appropriate safety precautions for hydrostatic drive systems.
4. Diagnose and test hydrostatic operation and components:
   a) directional control
   b) flow
   c) pressure
   d) sequence
   e) priority
   f) hydraulic motors
   g) cylinder
   h) accumulators
   i) hydraulic connections
5. Repair and or replace hydrostatic drive components.

SECTION THREE ..... ELECTRICAL/ELECTRONIC CONTROL SYSTEMS ..... 25 HOURS

A. Safety Interlocks and Relays ..... 15 Hours

Outcome: Service interlock systems for power equipment.

1. Identify relays and safety interlock systems as found in turf and power equipment.
2. Trouble shoot relays and safety interlock problems.
3. Describe computer controlled systems.

B. Computer and Automated Control Systems ..... 10 Hours

Outcome: Service automated control systems for power equipment.

1. Distinguish between Programmable and non-programmable (analog and digital) systems.
2. Diagnose and troubleshoot control systems.
3. Describe delay switch / timer operation.
4. Diagnose and troubleshoot delay switches and timers.

SECTION FOUR ..... CUTTING UNITS ..... 30 HOURS

A. Mowing Equipment ..... 1 Hour

Outcome: Describes power equipment cutting systems.

1. Describe and identify mowing equipment:
   a) golf course equipment
   b) parks equipment
   c) residential equipment

B. Mower Set-up ..... 4 Hours

Outcome: Set up mowers for specified cutting tasks

1. Describe operation adjustment and set up of reel mowers:
   a) reel
   b) bed knife
   c) rollers
   d) shields
2. Describe operation and set up of rotary mowers:
   a) clipping dispersal decks
   b) mulching decks
   c) blade drives
   d) blade types
   e) blade tip speeds
   f) set-up
   g) leveling
3. Describe flail mowers:
   a) blade types
   b) set-up

C. Blade Sharpening ..... 20 Hours

Outcome: Sharpen power equipment cutting blades.

1. Perform the following sharpening techniques:
   a) relief grinding
   b) spin grinding
   c) bed knife grinding
   d) rotary blade sharpening
   e) back lapping
2. Describe bed knife maintenance tools.

D. Chainsaw Chain and Cutting Bar ..... 5 Hours

Outcome: Sharpen and service chainsaw chains and teeth.

1. Identify chain types and application of each.
2. Perform chain sharpening using grinders and files.
3. Repair cutting chain sprocket and bar.
4. Perform bar maintenance.
5. Set up and adjust chain, brake and oiling system.
6. Perform chain maintenance and troubleshoot chain problems.

SECTION FIVE ..... POWER EQUIPMENT ..... 30 HOURS

A. Handheld Power Equipment ..... 10 Hours

Outcome: Service handheld equipment.

1. Describe chain saw operation.
2. Perform chainsaw troubleshooting and repair.

3. Describe string trimmer operation.
4. Perform string trimmer troubleshooting and repair.

B. Portable Water Pumps ..... 4 Hours

Outcome: Service water pumps.

1. Describe water pump operation and parts.
2. Troubleshoot pump operation.
3. Disassemble and diagnose water pump problems.
4. Reassemble and adjust water pump.

C. High Pressure Washers ..... 6 Hours

Outcome: Service high pressure washers.

1. Describe high-pressure washer operation and parts.
2. Perform high-pressure washer adjustment.
3. Troubleshoot high-pressure washer operation.
4. Perform overhaul of high-pressure pump.

D. Portable Generators ..... 10 Hours

Outcome: Service portable generators.

1. Describe and identify portable generator types:
   a) standard
   b) bobbin
   c) condenser
   d) inverter
2. Describe and test electrical components:
   a) exciter winding
   b) sensor winding
   c) sub winding
   d) field winding rotor
   e) capacitor
   f) rectifier testing
   g) back up coil.
3. Describe electrical safety precautions when dealing with domestic current.
4. Perform the following generator tests:
   a) AC output (110 – 240)
   b) DC output
   c) 12 volt field test
   d) low oil shut down
   e) electric fuel solenoid
   f) output frequency and voltage
   g) governor and auto throttle adjustment
   h) auto start operation
   i) loaded engine rpm
5. Perform an overhaul of the generator unit.

SECTION SIX ..... SPRAYERS ..... 10 HOURS

A. Sprayer Equipment, Chemicals and Handling ..... 4 Hours

Outcome: Describe chemical sprayers and the handling of equipment used for spraying chemicals.

1. Describe chemical sprayers as used in the power equipment and turf industry.
2. Describe the precautions required for working with spray chemicals.
3. Describe handling and disposal of various spray chemicals.
4. Describe and identify sprayer components and spray circuits:
   a) tanks
   b) pumps
   c) regulators and gauges
   d) screens and filters
   e) plumbing
   f) nozzles

B. Sprayer Maintenance ..... 6 Hours

Outcome: Service chemical spraying equipment.

1. Diagnose and troubleshoot spray systems and pressures.
2. Perform a typical calibration.
3. Describe loading sprayers
4. Describe sprayer storing and cleaning.
5. Describe sprayer winterizing procedures.

SECTION SEVEN ..... IRRIGATION ..... 20 HOURS

A. Irrigation Hydraulics ..... 1 Hour

Outcome: Describe irrigation hydraulics.

1. Describe irrigation hydraulic fundamentals:
   a) pressure conversion
   b) friction loss
   c) flow velocity
   d) H2O hammer.

B. Irrigation Equipment ..... 9 Hours

Outcome: Describe irrigation hydraulic equipment.

1. Identify heads, types and coverage characteristics.
2. Service and inspect heads.
3. Describe solenoid valves.
4. Describe valves and controllers.
5. Describe field satellite operation.
6. Describe irrigation plumbing and piping.
7. Describe irrigation fittings.
8. Describe the purpose of thrust blocks.

9. Describe pumping systems.
10. Describe irrigation pumps.
11. Describe pump drives replacement.

C. Irrigation System Service ..... 10 Hours

Outcome: Service irrigation hydraulic equipment.

1. Describe basic system design.
2. Describe equipment selection.
3. Describe system maintenance.
4. Describe operational maintenance.
5. Describe shut down and start up.
6. Describe irrigation system winterization procedures.

SECTION EIGHT ..... GOLF CARTS ..... 15 HOURS

A. Electric Carts and Chargers ..... 10 Hours

Outcome: Describe golf carts and golf cart fleet maintenance.

1. Describe the operation of electric golf carts.
2. Describe deep cycle 36 and 48-volt systems.
3. Describe the operating requirements for battery powered golf carts.
4. Describe deep cycle battery servicing procedure.
5. Test deep cycle battery condition and capacity.
6. Diagnose and test operation of electric components.
7. Describe line voltage charging systems.
8. Test and diagnose charger condition and output.
9. Describe fleet rotation and cart barn set up.

B. Golf Cart Mechanicals ..... 5 Hours

Outcome: Service golf carts and golf cart equipment.

1. Describe golf cart steering boxes:
   a) worm gear
   b) rack and pinion.
2. Service and adjust golf cart steering systems.
3. Describe the golf cart two-stroke engine reversing system.
4. Describe starter generator systems.

Excellence through training and experience

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